INGRESS OBSERVATIONS OF THE 1980 ECLIPSE OF THE SYMBIOTIC STAR CI CYGNI

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INTRODUCTION

One of the major results from the IUE may prove to be the new knowledge gained by studies of the ultraviolet spectra of symbiotic stars. Symbiotics combine spectral features of a cool M giant-like photosphere with strong high excitation emission lines of nebular origin, superposed. An excellent pre-UV review has been given by Swings (1). The UV spectra are dominated by intense permitted and semi-forbidden emission lines and weak continua indicative of hot compact objects and accretion disks. Two symbiotics, AR Pav and CI Cyg are thought to be eclipsing binaries, and we have begun IUE observations during the predicted 1980 eclipse of CI Cygni.

SYSTEM PARAMETERS

Periodic albeit irregular light curve variations suggest that CI Cyg is an eclipsing binary, with the elements: minimum light = JD 2411902+855.25E. Boyarchuk has predicted ingress to begin about April 10, 1980 and egress to end about August 18, 1980, with a nearly 100 day totality. The visual magnitude range fluctuates between $+10^m$ and $+12^m$ with outbursts to $+9^m$ known. Light curves are described by Mattei (2) and Belyakina (3).

QUESTIONS TO BE ADDRESSED

Obviously the time variation of the UV line and continuum flux can be used to constrain the physical dimensions of the line-emitting regions and thereby used to discriminate among various excitation mechanisms. It may be possible to determine something about the origin and extent of mass transfer. Since the system inclination is known, information about the existence and nature of an accretion disk might be obtained, as well. These questions are posed in the light of recent IUE studies which will also be presented at this conference. In particular, Plavec (4) argues that a connection between Beta Lyr stars, W Ser stars and symbiotics (AR Pav) can be made in commonality as case B mass-transferring binaries (rates of -6 or more in the log) and accretion onto non-degenerate stars. IUE observations of RW Hya by Kafatos et al. (5) have been used to argue that tidal interaction on the cool object can greatly augment the intrinsic stellar wind and lead to the observed accretion effects. The visibility of UV continua from accretion disks among symbiotics may be a complicated function of densities and viewing angles.

We hope to be able to address several of these concerns with eclipse observations of CI Cyg.

PRE-INGRESS AND INGRESS OBSERVATIONS

At the time of this writing we have obtained spectra on March 16, and April 16 and 25. The March 16 spectra in SWP and LWR are remarkably similar to RW Hya (5) in showing numerous strong high excitation emission lines from species like permitted N V and C IV and semi-forbidden O IV, O III and N III, among others. In contrast to RW Hya where evidence for a 100,000 K continuum is seen, CI Cyg shows a weak Balmer continuum emission falling off towards higher frequencies. Also CI Cyg shows strong O III lines at 3047 and 3133 Å which are frequently seen in Miras and planetary nebulae but not strongly in RW Hya. These are Bowen fluoresced by He II Lyα. The measured line fluxes in CI Cyg are generally 2 to 10 percent of those in RW Hya. C IV 1550 for example had an integrated flux of about 2E-11 ergs/cm^2/s on March 16, 1980. We note that for reasonable assumptions about distance (cf. 5) for CI Cygni, we can compare fluxes in C IV against Mg II for symbiotics much as Ayres has done for normal cool stars (see paper by Ayres in these proceedings) and find symbiotics like CI Cyg and RW Hya lie three orders of magnitude above the C IV-Mg II flux correlation for normal cool stars. We interpret this to be a manifestation of different physical mechanisms involved: magneto-acoustic heating of the outer atmosphere for normal cool stars, versus photoionization-recombination for the symbiotics.

A preliminary comparison of the spectra obtained during ingress indicate a substantial decrease in the continuum at all wavelengths and a noticeable drop in the emission line flux from the higher excitation lines, particularly in the 1400 Å blend of Si IV and O IV. A lie at 2830 Å due to He I also appears to be decreasing in strength, while the O III lines at 3047 Å and 3133 Å may have slightly increased in strength. These changes are suggestive of a stratified nebula, where the highest excitation regions are centralized and of dimensions less than that of the M giant, of order 10^{12} cm. This region could represent the actual accretion disk. The O III lines may arise from a more extended region (Bowen fluoresced), perhaps comparable to the orbital separation, of order 10^{14} cm. It is not obvious that we have detected a hot companion star, given the weak cool continuum. Comparison with observations well out of eclipse and during a burst stage would be useful. If other observers would like to supplement the observing plan, collaboration would be welcomed.

REFERENCES

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